REMARKS

Applicants appreciate the detailed examination evidenced by the Office Action mailed July 12, 2005 (hereinafter "Office Action"). Applicants have amended the specification and Claim 29 to correct the errors noted by the Examiner, and have amended Claims 32-34 to clarify the nature of the claimed invention. Applicants have amended independent Claims 1 and 10 to clarify that these claims recite apparatus and methods that produce a "useful, concrete and tangible result," namely, a simulation of plasma in a plasma reaction chamber having defined physical characteristics. Applicants respectfully traverse the rejections of Claims 1-35 under 35 U.S.C. § 103 based on the cited combination of U.S. Patent No. 6,014,943 to Arami (hereinafter "Arami") and the article "Two-Dimensional Self-Consistent Radio Frequency Plasma Simulations Relevant to the Gaseous Electronics Conference RF Reference Cell" by Lymberopoulos and Economou (hereinafter "Lymberopoulos"), as neither of these references provide the teachings alleged in the Office Action.

The objections to the specification and claims are overcome

Applicants have amended the specification and Claim 29 to correct the errors noted by the Examiner and, therefore, request withdrawal of the objections.

The § 112 rejections are overcome

Applicants have amended Claims 32-34 to clarify the nature of the claimed subject matter. In particular, the claims have been amend to clarify that the computer-readable recording medium is configured to include the recited modules. Applicants, therefore, request withdrawal of the rejections.

The § 101 rejections are overcome

The Office Action rejects Claims 1-18 under 35 U.S.C. § 101 as allegedly reciting non-statutory subject matter. Applicants respectfully disagree, as these claims relate to a real-world application, *i.e.*, plasma processing in a chamber with particular characteristics. One type of statutory subject matter are processes (and apparatus) that involve manipulation of data representing physical objects or activities. MPEP 2106. However, to further clarify

the nature of the claimed invention, Applicants have amended Claim 1 to explicitly include "obtaining configuration and process condition data for the reactor chamber" and "computing plasma characteristics for each of a plurality of cross-sections of the reaction chamber from the configuration and process condition data," thus clarifying that data relating to a physical object (a reaction chamber) is manipulated. Apparatus Claim 10 has been similarly amended. Applicants submit that Claims 1-18 meet the requirements of 35 U.S.C. § 101.

Independent Claims 1, 10, 19, 28 and 32 are patentable over Arami in view of Lymberopoulos

Claims 1-35 stand rejected under 35 U.S.C. § 103 as being unpatentable over Arami in view of Lymberopoulos in further view of Applicants' Own Admission (hereinafter "AOA"). With respect to Claim 1, the Office Action first asserts that Arami discloses "computing plasma characteristics for each of a plurality of cross sections of the reactor chamber (Fig. 2)" and "generating a generalized model of the plasma from the computer plasma characteristics for the plurality of cross-sections." Office Action, page 6. However, in the next sentence, the Office Action immediately contradicts this by stating "Arami fails to disclose plasma characteristics and generating a model of plasma from computed plasma characteristics for a plurality of cross sections," which appears to imply that Arami fails to disclose "computing plasma characteristics for each of a plurality of cross-sections of the reaction chamber" and "generating a generalized model of the plasma from the computed plasma characteristics for the plurality of cross-sections," as recited in Claim 1. The Office Action then states that Lymberopoulos "discloses plasma characteristics . . . and generating a model of plasma from the computed plasma characteristics for a plurality of cross sections," which Applicants note does not correspond to the above-quoted recitations of Claim 1. Accordingly, the rejection of Claim 1 is contradictory and incomplete and, for at least this reasons, the rejection of Claim 1 is erroneous and should be withdrawn.

Applicants note that Arami fails to disclose or suggest "computing plasma characteristics for each of a plurality of cross-sections of the reaction chamber" and "generating a generalized model of the plasma from the computed plasma characteristics for the plurality of cross-sections," as Arami describes a plasma processing device and methods of operating the device, but appears devoid of any description or suggestion of computation

of plasma characteristics for cross-sections of a reaction chamber, or use of the computed characteristics from the cross-sections to generate a generalized model of plasma. The only mention of behavior of plasma in the reactor chamber described in Arami appears to be a discussion of magnetic fields and non-specific references to plasma density. *See, e.g.*., Arami, columns 7 and 8.

It appears that the Office Action contends that Lymberopoulos teaches "computing plasma characteristics for each of a plurality of cross-sections of the reaction chamber" and "generating a generalized model of the plasma from the computed plasma characteristics for the plurality of cross-sections," as recited in Claim 1. While Lymberopoulos deals with plasma simulation, Applicants submit that it does not disclose or suggest the above-quoted recitations of Claim 1. In particular, the Office Action cites page 473, right column, paragraph two, lines 9-11 of Lymberopoulos as disclosing plasma characteristics. Office Action, p. 6. However, this passage simply states that "[t]he Reference Cell is thought to be a well-characterized system in which fundamental studies of plasma behavior can be conducted." There is nothing here about "computing plasma characteristics for each of a plurality of cross-sections of the reaction chamber." Moreover, the "Reference Cell" in Lymberopoulos does not appear to have the characteristics of the plasma reactor recited in Claim 1, *e.g.*., it does not appear to include "a plurality of magnets that move with respect to the reaction chamber." The Reference Cell in Lymberopoulos appears to be a different type of reactor than the dipole ring magnet plasma reactor described in Arami.

The Office Action appears to further assert that lines 1-2 under the title "Plasma Simulation" on page 475 of Lymberopoulos teach "generating a generalized model of the plasma from the computed plasma characteristics for the plurality of cross-sections." However, this passage (in extended form) merely states that "[m]odeling and simulation of glow discharge plasmas has emerged as a tool for enhancing one's intuition about the physicochemical processes occurring in the plasma, for understanding the complex spatiotemporal plasma dynamics, and for assisting in the design of new reactors or the optimization of existing ones." There appears to be nothing here that teaches or suggests "generating a generalized model of the plasma from the computed plasma characteristics for

the plurality of cross-sections." Accordingly, the cited combination of Arami and Lymberopoulos does not teach or suggest all of the recitations of Claim 1.

Moreover, the Office Action fails to provide clear and particular evidence from the prior art of a motivation or suggestion to combine Arami and Lymberopoulos in the matter attempted in the Office Action. The Office Action asserts that it would have been obvious to combine these references "to understand surface reaction and other behaviors associated with the plasma processing and to reduce the cost and time by simulating plasma characteristics." Office Action, pp. 6 and 7. This is a vague and conclusory assertion that is unsupported by evidence from the prior art. For example, the Office Action points to no evidence in the cited references or elsewhere in the prior art as to how the specific simulations described in Lymberopoulos could be applied to a reactor such as that described in Arami, or why this would be particularly advantageous. In fact, Applicants submits that such evidence is not present, as, among other things, Arami and Lymberopoulos deal with two fundamentally different types of reactor configurations (a dipole ring magnet (DRM) device versus a Reference Cell) and there is no discussion in the Office Action (or the references) of any relationship between plasma behavior in these different types of devices in the Office Action or the cited references or how or why simulation techniques used in one type of reactor would be applicable to the other type of reactor.

For at least the foregoing reasons, Applicants submit that Claim 1 is patentable. Applicant submits that independent Claims 10 and 19, which are apparatus and computer program product analogs of Claim 1, are patentable for at least similar reasons.

Independent Claims 28 and 32 are patentable for at least similar reasons. The Office Action concedes that Arami fails to disclose or suggest any of the recitations (a), (c) or (d) of Claim 28. Office Action, p. 11. The Office Action cites the right hand column of page 474 of Lymberopoulos as teaching recitation (a) ("inputting a plasma reactor shape and process conditions and inputting plasma collision reaction data") and recitation (c) ("computing electron density and temperature by a Monte Carlo method and interpreting the transmission phenomenon of ion and neutral species using the data of the steps (a) and (b) until they are converged"), and recitation (d) ("obtaining overall plasma characteristics using the converged values"). However, nowhere does the Office Action indicate that Lymberopoulos teaches

recitation (b) ("3-dimensionally computing static magnetic fields induced by the permanent magnets"), which would seem to be required if the Office Action asserts that Lymberopoulos teaches recitation (d), which includes "using the data of the steps (a) and (b)." Moreover, the Office Action provides no evidence of a motivation to combine the cited references to produce the recitations of independent Claims 28 or 32. In fact, as discussed above, there is no evidence in the cited references as to how or why the simulation technique described for the Reference Cell of Lymberopoulos would be applied to the different types of plasma reactors described in Arami and AOA. For at least these reasons, Applicants submit that independent Claims 28 and 32 are patentable.

The dependent claims are patentable

Applicants submit that the dependent claims are patentable at least by virtue of the patentability of the various ones of independent Claims 1, 10, 19, 28 and 32 from which they depend. Applicants further submit that several of the dependent claims are separately patentable.

For example, Claim 2 recites "wherein the plurality of moving magnets rotate about an axis of rotation, and wherein each of the plurality of cross-sections includes the axis of rotation." In rejecting Claim 2, the Office Action cites column 2, lines 35-36, column 6, lines 42-45 and Fig. 2 as teaching such recitations. However, while the column 2 and column 6 passages do describe a dipole ring magnet arrangement and Fig. 2 shows a dipole ring magnet, none of these disclose or suggest "computing plasma characteristics for each of a plurality of cross-sections of the reaction chamber" that include "the axis of rotation." As noted above, Arami simply does not deal with plasma simulation. For at least these reasons, Applicants submit that Claim 2, and related apparatus and computer program product Claims 11 and 20, are separately patentable.

Claim 3 recites:

> . . . wherein computing plasma characteristics for each of a plurality of cross-sections of the reaction chamber comprises performing the following actions for each of the cross-sections:
>
> computing electron density and temperature for the cross-section using an iterative Monte Carlo computational procedure; and

computing ion and neutral species transmission phenomena for the cross-section from a plasma dynamics simulation.

In rejecting Claim 3, the Office Action first cites a passage from page 481 of Lymberopoulos as teaching "computing electron density and temperature." This is incorrect. The passage starting with "Combining Eq. (36) . . ." deals with computing ***electron flux*** from electron density and temperature, not computing electron density and temperature. The reference to the passage on page 475 of Lymberopoulos cited as teaching use of Monte Carlo computation of electron density and temperature for a cross-section appears to have nothing to do with the passage on page 481, and merely states that Monte Carlo simulation techniques can be used in glow charge simulations. There is nothing in the cited material that teaches or suggests "computing electron density and temperature for the cross-section using an iterative Monte Carlo computational procedure." For at least these reasons, Applicants submit that Claim 3, and related apparatus and computer program product Claims 12 and 21 are separately patentable.

Claim 5 recites "determining a static magnetic field generated by the moving magnets, and wherein computing plasma characteristics for each of a plurality of cross-sections of the reaction chamber comprises computing the plasma characteristics for each of the plurality of cross-sections from the determined static magnetic field, shape information for the reaction chamber, and plasma collision reaction data." The Office Action cites column 1, lines 30-35 and Fig. 4 of Arami as disclosing a static magnetic field (Office Action, p. 7.). The cited passage from column 1 merely states that a dipole ring magnet reactor can provided improved uniformity of a magnetic field, while Fig. 4 illustrates that "a magnetic field is formed substantially in parallel to the plane surface including the wafer W . . . when the dipole ring magnet 41 is at a standstill." Arami, column 7, lines 51-54. There is nothing here that teaches or suggests "determining a static magnetic field generated by the ***moving*** magnets." The Office Action cites Lymberopoulos as teaching "computing plasma characteristics for each of the plurality of cross-sections from the determined shape information (anisotropy (shape of microscopic features etched into the wafer)." Respectfully, this is not what is claimed. The recited "shape information" is "for the reactor chamber." There is nothing about wafer features in Claim 5. For at least these reasons, Applicants submit that Claim 5,

and related apparatus and computer program product Claims 14 and 23 are separately patentable.

Similar misapplications of the references are found throughout the rejections of the dependent claims. Applicants respectfully note that each of these rejections is characterized by noting superficial correspondences between features in the references and the claims that are related only because the claims and the references use some common terminology (*e.g.*., "Monte Carlo simulation," "electron density," "temperature," etc.). Applicants are claiming specific operations in simulations, not, broad, general concepts like "Monte Carlo computation" and "plasma simulation." The Office Action generally does not provide evidence as to where such ***specific*** claim recitations are taught or suggested by the references, and accordingly, Applicants submit that many of rejections of the dependent claims are erroneous and should be withdrawn. In the interest of brevity, Applicants defer further discussion of the separate patentability of the dependent claims pending consideration of the issues discussed above.

Conclusion

Applicants submit that the objections to the specifications and claims have been overcome, and that the claims are patentable for at least the reasons discussed above. Applicants respectfully request allowance of the claims and passing of the application to issue in due course. Applicants encourage the Examiner to contact the undersigned by telephone to resolve any remaining issues.

Respectfully submitted,

Robert M. Meeks
Registration No. 40,723
Attorney for Applicant(s)

USPTO Customer No. 20792
Myers Bigel Sibley & Sajovec
Post Office Box 37428
Raleigh, North Carolina 27627
Telephone: 919/854-1400
Facsimile: 919/854-1401

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on October 6, 2005.

Candi L. Riggs